

October 2015

4-H 405 Water Riches for Youth : Technical Expert Workbook

Follow this and additional works at: <http://digitalcommons.unl.edu/a4hhistory>

"4-H 405 Water Riches for Youth : Technical Expert Workbook" (2015). *Nebraska 4-H Clubs: Historical Materials and Publications*. 410.
<http://digitalcommons.unl.edu/a4hhistory/410>

This Article is brought to you for free and open access by the 4-H Youth Development at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nebraska 4-H Clubs: Historical Materials and Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.



4-H 405



Technical Expert Workbook



4-H Youth Development
Cooperative Extension, Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln



Date _____

Your name, _____

Your title _____

Your business name _____

Business address _____

City _____

State _____

ZIP _____

Dear _____ :
Your name

As you probably are aware, our city's current landfill has been condemned and the city must build a new one and have it operational in 24 months. Because of this immediate problem, I am in the process of putting together a task force to help locate a new landfill.

I am asking you to serve on this committee. All the task force members will provide a balance of knowledge, insight and interest, you have knowledge of scientific principles in nature and expertise in water resources management that will make you an invaluable member of this team.

Some of the ground work has already been laid for this task force. My office has narrowed the number of possible sites down to five. Once the task force has met and discussed all five sites, your committee will narrow the field to three, then two, and finally, to its final recommended site.

We hope this will be a rewarding experience for you. I feel it will be very beneficial to bring together a cross-section of professionals and citizens to help make this important decision. I thank you, in advance, for the time and effort you will put in to help your community in this way.

The first meeting of this task force will be _____
Day, Date, Time, Location

If you have any questions, feel free to call my office at _____
We look forward to meeting you at the first meeting. Your mayor's office phone number

Sincerely,

Mayor

You just arrived at work and opened the following letter. Congratulations! You are now part of a special project to help your community overcome a serious problem.

A technical expert might be a hydrologist, a soil scientist or a research specialist in water resources.

Think about some of the possibilities, then you decide which career professional you are for this program. Once you decide, fill in the appropriate information within this letter.



The Role of the Technical Expert

On this team, you are the technical expert – the one person who has studied water issues so thoroughly that your teammates can ask you just about anything they want to know about how this landfill will affect water quality around any of the five sites. Your role is very important! You will help your team discuss this issue based on **FACTS**.

Obviously, before you can relate information to your teammates, you are going to have to learn the subject for yourself. You are going to have to read and understand a great deal of information in a short amount of time. You are also going to have to learn to **RESEARCH** answers to questions that you don't know.

While this packet and the teacher's resource library will provide some of the information you need to do your best, it will be up to you to use other library materials, make phone calls to businesses and agencies who might be able to answer some of your questions, and explore other ways to answer the types of questions you will be asking.

You also are playing an important role because you know that a group of scientists is studying some things in the area of Site B. Because of this long-term research, you do not want Site B to be selected!

Since you are a technical expert you will need to address the technical suitability of each site for the landfill. Technical experts always try to remain unbiased and present only technical, factual information. This can sometimes cause conflict when you have a personal opinion associated with one of the alternatives. In order to maintain your technical credibility you must be careful to distinguish between facts and personal opinion.

Good luck! And happy researching.

During this project, you are going to become very familiar with water. You'll learn a great deal about:

- the scientific research process,
- the hydrologic cycle,
- Earth's water supplies,
- how water supplies get contaminated,
- how water supplies can be protected and
- learning about water contaminants.

Read this carefully to
discover your inside
information.



Overview

Welcome to *Water Riches for YOUth!* You're going to find this a different kind of learning activity, so pay close attention.

This situation involves locating a new landfill in your community from among five sites. Careful consideration must be given to this issue. Your team must consider a variety of social, economic, political and environmental issues when determining which site to recommend.

You have been assigned to a community task force. The mayor's letter identified a serious problem with the landfill and a solution must be found.

As a member of this task force or team, you will take the role of a community resident with particular views and perspectives of the problem. The different ideas from the team members will help reach the best decision.

If you don't understand how this activity works, you're going to have trouble serving as a team member, so please:

- **READ** this workbook carefully,
- **THINK** about your responsibility to your group, and
- **PERFORM** your role so your group can work effectively.

This workbook will guide you through an interesting team problem-solving activity.

NOTE: You are the **ONLY** member of your team receiving the information contained in this workbook. You need to understand your role and the information in this workbook.

Remember, a team is only as good as its weakest member. Do the best job you can — that's all your team asks.

**You are the only member
on your team receiving
this information.**

Here's How This Activity Works

◆ Study the Sites

Your teacher will provide site sheets with basic data and maps. Study the information provided. Ask questions. Search for other additional information that will help to make a decision. Look for long term and short term impacts of different decisions. Talk to experts in your community to help you gather information. You may have to make assumptions or guess about how the sites might be used and the environmental threats at the sites.

◆ Group Meetings

Your group will alternate between GROUP MEETINGS and INDIVIDUAL WORK SESSIONS. Your teacher will help you get the first group meeting underway and may call additional meetings from time to time when necessary.

The Team Leader will call the group meetings.

During the group sessions, you will discuss which landfill site to select. When your team seems ready (has discussed the issues, looked at options, weighed the trade-offs of each site), you may call for a vote to determine the end of one round and the beginning of the next round. At the end of each meeting you'll need to complete the questions at the end of your workbook and discuss how your team is working.

◆ Rounds

During Round 1, all five sites will be discussed, and a vote will be taken to decide which three sites to continue discussing.

During Round 2, three sites will be discussed, and a vote will be taken to decide which two sites to continue discussing.

During Round 3, two sites will be discussed and a final vote will be taken to decide which site the group supports.

◆ Individual Work sessions

During the individual work sessions, each team member will work from his/her workbook, will work to find answers to questions that arose during the previous group session, and will work on the laboratory experiences and special activities the teacher may assign.

◆ Your Unique Role

Each person has a specific role, different from the others on the team. Read about the group problem. Talk with your parents and others in the community for ideas. Participate in the meetings as you think someone in your role would act.

Your teacher will evaluate the productivity of the entire group as well as your contribution.

REMEMBER: You may hold more than one group session during a round!



Moving Through the Rounds

Be Prepared!

One of the best ways to approach a problem-solving activity is to come to the meetings prepared. By writing down what you want to accomplish, when, how and who should be involved, you will help the group find workable alternatives and solutions.

This group problem-solving activity will take place in three rounds. Round 1 will begin only after the Team Leader and teacher believe you are prepared. Rounds Two and Three will be called in that same manner.

If team members need more time to gather information or ask more questions — either individually or in group discussion — the round continues. **A ROUND ENDS ONLY AFTER A VOTE IS TAKEN!**

ROUND 1:

- The group will meet to discuss the features, advantages and disadvantages of each of the five possible sites for the landfill. You have a specific goal to keep the landfill away from your site, you will probably want to enter Round 1 with strong arguments in favor of the other sites and against the one closest to you.
- Before closing Round 1, the group will VOTE to continue studying **THREE** sites.

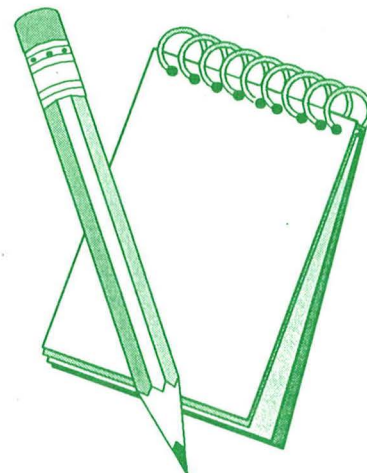
ROUND 2:

- Discuss the advantages, disadvantages, alternatives to and consequences of the three sites still being considered.
- Vote on the three sites to narrow the field to two.

ROUND 3:

- Discuss the two sites, as above.
- Vote on which site group prefers.
- Prepare for final presentation, as teacher directs.

This workbook has a series of activities that you will complete during this project. Your teacher may provide additional activities and resources for you to use.



Water: The Universal Solvent

Understanding the Numbers

Because of advances in analytical equipment and measurement techniques, trace elements of man-made and natural chemicals can be detected in *parts per billion* or even *parts per trillion*. The following comparisons may help you understand these numbers better.

Think of one part per million as:

- 1 inch in 16 miles,
- 1 minute in 2 years,
- 1 cent in \$10,000,
- 1 ounce of salt in 31 tons of potato chips, or
- 1 bad apple in 2,000 barrels.

One part per billion compares with:

- 1 inch in 16,000 miles,
- 1 second in 32 years,
- 1 cent in \$10 million,
- 1 pinch of salt in 10 tons of potato chips,
- 1 lob in 1,200,000 tennis matches, or
- 1 bad apple in 2 million barrels.

One part per trillion compares with:

- 1 postage stamp in an area the size of Dallas,
- 1 inch in 16 million miles (more than 600 times around the earth),
- 1 second in 320 centuries,
- 1 flea on 360 million elephants,
- 1 grain of sugar in an Olympic-sized pool, or
- 1 bad apple in 2 billion barrels.

1 ppm = 1 milligram per liter

1 ppb = 1 microgram per liter

Water is often called the UNIVERSAL SOLVENT because it can dissolve some amount of almost any material it comes in contact with. Some materials dissolve much easier than others and large amounts can be dissolved. Once dissolved, the material can be carried long distances by the water.

Because of this, water in its pure form of two parts hydrogen and one part oxygen is rarely found in nature. As it falls from the sky, rain droplets and snowflakes collect dust and other impurities that exist in the air. Once on the surface, more impurities "hitchhike" along with the water molecules.

These impurities are then either deposited somewhere along the surface or they travel with the water as it continues the cycle.

The fact that foreign substances exist in water is not necessarily cause for alarm or concern. Even though water is not "pure," however, does not mean it is not "safe." Water can be literally loaded with foreign substances, such as small amounts of iron, dirt, ashes, etc., and still be perfectly safe for humans, plants and animals to use. The problems arise when the foreign substances exist in quantities that are hazardous to the health or well-being of living things.

Water becomes unsafe to use when TOO MUCH of any substance or contaminant gets into a water supply. The amount that is designated "too much" varies from one substance to another. These amounts are often measured in units of "parts per million" or "parts per billion." That is, the number of "parts" (whether molecules, gallons or liters) of the substance found in the water for every million or billion "parts" (the same measure as used before) of water. For example, nitrate-nitrogen contamination is considered to be an acceptable risk in drinking water for young infants until it reaches beyond 10 parts per million. This means that in every million parts of water (whether it be molecules, milliliters or liters) that water also contains 10 parts of nitrate-nitrogen.

The standards set for drinking water quality vary a lot depending on the specific chemical.

The danger levels for contaminants in drinking water are established by the Environmental Protection Agency. Public water supplies must be tested by a certified laboratory on a regular basis to assure that they are safe. Laboratory equipment and methods allow the measurement of extremely small amounts of contaminants in our water supplies.



Locate a complete list of standards that a public drinking water supply must meet.

List drinking water maximum contaminant levels for these common substances.

example: Carbon Tetrachloride - 0.005 mg/L

Atrazine (a herbicide)	_____
Copper	_____
Iron	_____
Manganese	_____
Nitrate Nitrogen	_____
Sulfate	_____

Questions:

Who determines if the level of contamination in water is too high for human use in your community?

What substance or products in your community (individual, agricultural and residential) pose the greatest threat to the ground water?

You can find the drinking water standards from a number of possible sources. These include:

City/County Health Department

City Water Department/Supplier

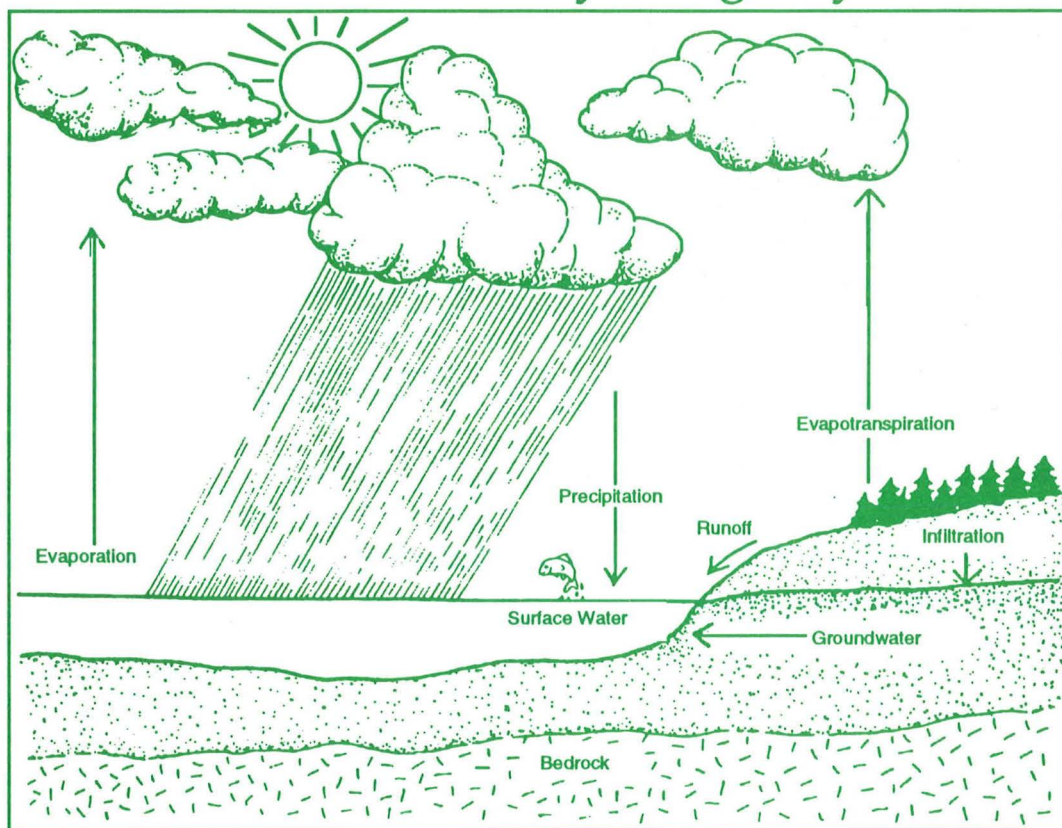
Water Testing Labs

Cooperative Extension

Consulting Engineers

Safe Drinking Water Hotline
(800) 426-4791

The Hydrologic Cycle



The amount of water on and in the earth has been about the same since the beginning of time. New water is not created and used water is not destroyed. It merely moves in a continuous cycle on, in and around the earth. This is called the **HYDROLOGIC CYCLE**.

Water can be found in the hydrologic cycle in three forms — gaseous, liquid and solid.

Water gets into the earth's atmosphere by turning into **VAPOR** — the gaseous form of water. Water vapor is carried into the atmosphere in the warm air that is heated by the sun. The warm, moist air rises because warm air is lighter than cool air.

Once the warm, moist air gets into the sky, it meets with cooler air and **CONDENSES**. As vapor condenses, the molecules cluster together and turn into **LIQUID** droplets.

When the droplets get too heavy to be held in the sky, they fall in the form of **PRECIPITATION**. Rain, sleet, hail and snow are all forms of precipitation. Hail, sleet and snow are the solid forms of water in the cycle.

The precipitation feeds plants and adds to the earth's supply of surface water — such as rivers, lakes and oceans and groundwater, which is stored in the soil layers.

The cycle is complete as water from the earth's surface is heated by the sun, turning it into a vapor. The process is called **EVAPORATION**. (Notice the word "vapor" in there?) Plants also give water vapor back to the atmosphere through a process called **TRANSPIRATION**.



Raindrops and Drinking Water

Have you thought about your drinking water and precipitation? Precipitation impacts your drinking water whether groundwater or surface water is your source of supply.

Some of the rain we receive becomes runoff that reaches rivers and lakes. These rivers and lakes can be a source of drinking.

Rainfall is the primary source of recharge for groundwater. If groundwater provides your drinking water, recharge is important to maintain the supply.

What is the source of drinking water supply?

At your school _____

At your home _____

Is your water provided by:

_____ a public water supply system

_____ a private water supply system

_____ a private well

_____ a private surface water supply

What is the average annual precipitation in your community? You may need to contact someone or look in the library for this information. Possible sources include a local radio or television meteorologist, the newspaper, science teacher, Cooperative Extension office, Soil Conservation Service office, Natural Resources District Office, or another resource management agency.

Total average precipitation _____ inches

Find the annual precipitation for your community for the past 10 years. Check with your teacher for the nearest weather station that might have this information. The sources above may be able to help you.

Total Annual Precipitation, inches

last year	_____
year 9	_____
year 8	_____
year 7	_____
year 6	_____
year 5	_____
year 4	_____
year 3	_____
year 2	_____
year 1	_____

(continued)

Look at the variation from year to year

What is the greatest difference above the average? _____ inches

What is the greatest difference below the average? _____ inches

How many years had above average precipitation? _____

How many years had below average precipitation? _____

The amount of runoff that occurs is dependent on several factors including the amount of precipitation, the type of soil, the topography of the land, and the vegetation on the land. Looking at the precipitation information you collected, which year do you expect might have had the most runoff?

What happens if we have excess runoff?

How can excess runoff affect drinking water supplies?

Would any of the last 10 years be considered drought years?

Which years?

How do you think the yearly variation in the amount of precipitation might affect your drinking water supply?



See if you find information on how the amount of precipitation might effect water quality. You may find this information helpful in your group meeting.

You might also want to look at monthly precipitation. There can be considerable variation in monthly precipitation from year to year.

Precipitation, inches						
Month	Year 1	Year 2	Year 3	Year 4	Year 5	Average
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Total						

What observations can you make about the monthly precipitation?



Earth's Water Supplies

Overview

Three-fourths of the earth's surface is water. And about 97 percent of the earth's water is in the oceans. Ocean water and some inland lakes are saltwater and unusable by humans and plants, fish and animals not adapted to saltwater.

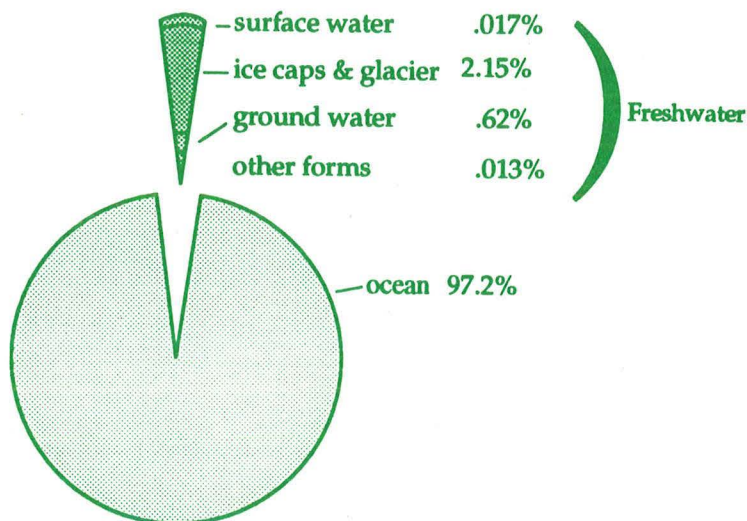
Only three percent of the earth's water is fresh water (not saltwater).

The amount of fresh surface water held in rivers, lakes and streams adds up to only about three percent of the amount of water held underground. If all the world's fresh surface water were brought together to form a single lake, that lake would cover the state of Indiana 1,500 m (nearly one mile) deep. But that would be small compared to a lake that could be formed by the earth's underground water supply.

If all the fresh groundwater lying within one-half mile of the earth's surface could be brought together, hydrologists (scientists who study Earth's water resources) estimate the lake would cover Texas, New Mexico, Colorado, Oklahoma, Kansas, Nebraska, Wyoming, South Dakota, North Dakota and Montana 1,500 m deep! So you can see why it is important to protect our ground water resources.

Surface water

When precipitation hits the ground, it either **INFILTRATES** into the soil, or it runs off along the top of the ground. Water **RUNOFF** flows downhill into streams, rivers, lakes and oceans. These visible bodies of water are known as **SURFACE WATER**.



Groundwater

Under the earth's surface, gravity moves the water downward through the spaces between soil particles, gravel and rock. Eventually the water reaches the **ZONE OF SATURATION** — a level underground where all the spaces between the rocks and soil particles are filled with water. We call this water **GROUND WATER**.

The top of the zone of saturation is called the **WATER TABLE**. Water from these zones of saturation can be used on the surface by drilling a well into the zone, creating a space into which water can flow, and then pumping the water to the surface.

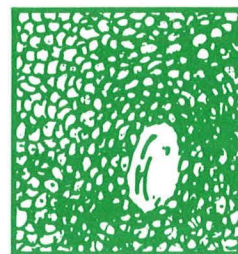
Areas of saturated rock, gravel and soil layers that will yield usable amounts of water are called **AQUIFERS**.

The amount of water that soaks into the ground depends on how well the water can enter (infiltrate) the soil. The ratio of open space to the total volume of the rock or soil determine the soil's **POROSITY**. The rate (speed) at which water can move through the soil particles is called the soil's **PERCOLATION RATE**.

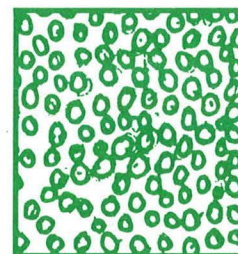
Clay soils have small soil particles that fit together tightly, thus creating very slow infiltration and percolation rates. Although clay soils have a high porosity, as much as 45-50%, the pores are very small which restrict the movement of water. Consolidated rock materials will have porosities in the 1-10% range and allow little water movement except when they are broken or fractured.

Sand, on the other hand, has large sized particles that fit loosely and with generous spaces between the particles. This causes sand to have fast infiltration and percolation rates. Sandy soils will have porosities of 20% to 35%.

See the illustrations to visualize how soil particles fit together and form air spaces through which water can travel.



Clay has very small particles that fit together tightly creating small pore spaces for water to move within.



Sand has large particles that fit loosely and allow plenty of space for water to move.



Water Holding Capacity and Permeability

This activity will help you to understand the difference in the amount water a soil material will hold and the differences in the rate that water will move through the materials.

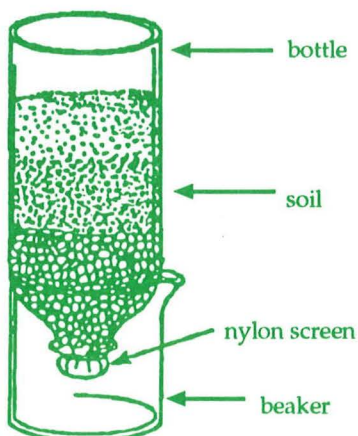
Materials needed:

3 plastic cups or 2 liter pop bottles
3 beakers
soil (clay or silt)
sand

gravel
water
graduated cylinder
stop watch

Procedure:

1. Prepare plastic cups or bottles so that water can drain from the bottom of the container. Punch a series of small holes in the plastic cups. Remove the bottom of the bottle and punch small holes in the cap or use a mesh over the bottle opening.



2. Before using your soil, sand, and gravel spread them on sheets of paper and allow them to completely dry. If your school science room has an oven, you can dry the materials in the oven.
3. Measure out equal volumes of soil, sand and gravel that will fill your plastic cups or bottles to within 1 inch of the top.
4. Suspend your cups or bottles over the beakers.
5. Fill your graduated cylinder with water. Record the beginning amount of water in the graduated cylinder on the "beginning reading" line.
6. Pour the water on your container of gravel until water starts to come out the bottom of the container.

7. Record the amount of water that remains in the graduated cylinder on the "ending reading" line.
8. Subtract the "ending reading" from the "beginning reading" and record your answer on the "amount of water retained" line. This is the approximate amount of water that was retained by the gravel. This amount of water that it took to cause water to come out the bottom gives you a relative measure of the water holding capacity of the material.

	Gravel	Sand	Soil
Graduated cylinder Beginning Reading, ml			
Graduated cylinder Ending Reading, ml			
Amount of Water Retained, ml			



Repeat steps 5, 6, 7 and 8 for the sand and soil. If your graduated cylinder is small, you may have to fill it more than one time.

What does this information tell you about the water-holding capacity of different earth materials?

6. Add additional water to your three containers to be sure the earth material is completely saturated with water. After the water stops draining, empty the beakers.
7. Place water in the graduated cylinder so there is approximately one-fourth the volume of the beaker. Record this amount of water.

_____ml.

8. You need someone to help you with this step. One person will operate the stop watch. The other person will pour the water on top of the soil, sand, and gravel. You need to pour the water quickly; you may need to place some filter paper on the surface to minimize the disturbance when you pour the water.

With the stop watch ready, quickly pour the water from the graduated cylinder into the cup or bottle. Start the watch as soon as all the water has been poured in. Stop the watch when the first drop of water appears at the bottom of the container. Record the time.

Repeat this step for each cup/bottle. Use exactly the same amount of water for each container. You may have to experiment with the amount of water you use, pouring the water, and exactly when you start the watch.

Results

	Time for water to move through the container
Soil	_____ sec.
Sand	_____ sec.
Gravel	_____ sec.

What do these results tell you about the permeability (rate that water moves through soil) of the earth materials?

Which material has the highest permeability rate?

Which material would have the greatest potential for allowing groundwater contamination to occur?

You can repeat this activity with various soils to evaluate the properties of soils at different sites, locations or depths.

Think about this activity in relationship to siting a landfill as you work with your classroom group.



Evaluating Our Progress after Round 1

Rate yourself on the following items with 5 being the best.

I was prepared for our meeting	5	4	3	2	1
I shared information that helped us evaluate the sites	5	4	3	2	1
I listened carefully to what others had to share	5	4	3	2	1
I asked questions to gain more information	5	4	3	2	1
When I didn't agree with someone, I did so in a friendly manner	5	4	3	2	1

What is one thing you can do next time to help the group function better ?

Answer the following questions as a group.

As a group, what are some things you all need to work on next time ?

What is the most important thing you accomplished in this round ?

What would you like to accomplish in the next round ?

Evaluating Our Progress after Round 2

Rate yourself on the following items with 5 being the best.

I was prepared for our meeting	5	4	3	2	1
I shared information that helped us evaluate the sites	5	4	3	2	1
I listened carefully to what others had to share	5	4	3	2	1
I asked questions to gain more information	5	4	3	2	1
When I didn't agree with someone, I did so in a friendly manner	5	4	3	2	1

(continued on page 17)



What is one thing you can do next time to help the group function better ?

Answer the following questions as a group.

What are some things you all need to work on next time ?

What is the most important thing you accomplished in this round ?

What would you like to accomplish in the next round ?

Evaluating Our Progress after Round 3

Rate yourself on the following items with 5 being the best.

I was prepared for our meeting	5	4	3	2	1
I shared information that helped us evaluate the sites	5	4	3	2	1
I listened carefully to what others had to share	5	4	3	2	1
I asked questions to gain more information	5	4	3	2	1
When I didn't agree with someone, I did so in a friendly manner	5	4	3	2	1

Answer the following questions as a group.

What is the most important thing you accomplished in this round ?

What do you feel the strengths of your group were ?

What do you feel the weakness of your group were ?

What other type of problems may you solve in the future using this same technique ?

Prepared by

Shirley Trout, Writer

DeLynn Hay, Extension Specialist Biological Systems Engineering

Ken Schmidt, Extension Youth Specialist

Karen Melang, 4-H Communications Coordinator

Deb Hall, 4-H Youth Specialist

Terri Trotter-Wiles, Editor

Kristi Snell, Graphic Designer



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.



It is the policy of the University of Nebraska-Lincoln Institute of Agriculture and Natural Resources not to discriminate on the basis of sex, age, handicap, race, color, religion, marital status, national or ethnic origin or sexual orientation.